Decline and Recovery of the Bathurst Caribou Herd: Workshops Held in Yellowknife, NWT October 1 and 2, and 5 and 6, 2009

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All drawings by Doug Urquhart, Whitehorse, YT.

EXECUTIVE SUMMARY

The Bathurst caribou herd declined rapidly from more than 100,000 in 2006 to an estimated 31,900 in June 2009. The herd is important to many hunters and communities across the Northwest Territories (NWT), and its annual range covers nearly 350,000 km^2 in the NWT, Nunavut and northern Saskatchewan. As part of a process of developing co-management plans for recovery of the Bathurst caribou herd, GNWT Environment and Natural Resources (ENR) organized two two-day workshops in Yellowknife on October 1 and 2, and 5 and 6, 2009. The purpose of the workshops was to review information about the herd's decline and explore management actions to promote the herd's recovery. Participants represented communities and organizations that valued this herd or were involved in managing it. This report includes much of the material presented at the workshops, along with summaries of key comments from participants.

Barren-ground caribou have traditionally gone through wide swings in numbers (cycles), based on traditional knowledge (TK) and technical studies across their North American range. All herds monitored by GNWT reached peak numbers in the 1980s and 1990s and declined in the 2000s, some to very low numbers. Many factors – fire on the winter range, disease, timing of spring, predators, hunter harvest, and industrial development – likely affect each herd, but every herd experiences individual conditions. Workshop participants reviewed the material presented and commented on the likely importance of these factors to the Bathurst herd.

Declines in two NWT herds (Cape Bathurst and Bluenose-West) from 2000 to 2006 showed a pattern of decline similar to that of the Bathurst herd: slow decline followed by faster decline at lower numbers. Although the Cape Bathurst and Bluenose-West herds would likely have declined between 2000 and 2006 for natural reasons, when hunter harvest levels stay about the same, harvesting can have an increasingly large effect at lower herd size. By

recommendation of co-management boards, all harvest on the Cape Bathurst herd was closed in 2007 and harvest of Bluenose-West caribou was reduced and shifted largely to bulls. Both herds showed initial stability from 2006 to 2009, based on July 2009 surveys.

The Bathurst herd declined gradually in the 1990s when it still numbered over 300,000. However, its rate of decline accelerated to 22-23% per year from 2006 to 2009. The Bathurst herd would likely have declined in the early 2000s for natural reasons, in part due to low calf survival. In the 1990s when the herd was much larger, the estimated annual harvest was likely a small percentage of the herd (3-5%). However, as the herd grew smaller in 2006-2009, the harvest, aided by easy access on winter roads and many skidoos and trucks, likely did not decrease.

By 2009 a harvest of 5,000-7,000 caribou/year, mostly cows, would have resulted in an annual harvest rate of 15-22% of the herd. The Bathurst Caribou Calculator, a population model, indicated that if the herd continued to decline this rate and the harvest continued at the same level, the herd could disappear in four to five years. All workshop participants recognized the urgency of taking management actions to allow the herd to recover. The importance of reducing harvest was recognized but action on other factors (e.g. fire on the winter range) was also recommended by participants.

Workshop participants discussed how various communities and groups might cope with hardships resulting from a reduction of the Bathurst hunt. Some communities south of Great Slave Lake had a variety of country food sources such as moose, muskoxen, bison, or fish. Other communities, particularly Lutselk'e and the off-road Tłı̨chǫ communities, had higher food costs and had few alternatives to caribou. Management would need to address alternatives for these communities.

Many participants stressed the need for further meetings in all the communities. Formally, management actions for the Bathurst herd were likely to be recommended by the Wek'èezhìi Renewable Resources Board in early 2010. Everyone would have opportunities to help the Bathurst herd recover.

(Photo credits: Archana Bali)

(Photo credit: ENR, GNWT)

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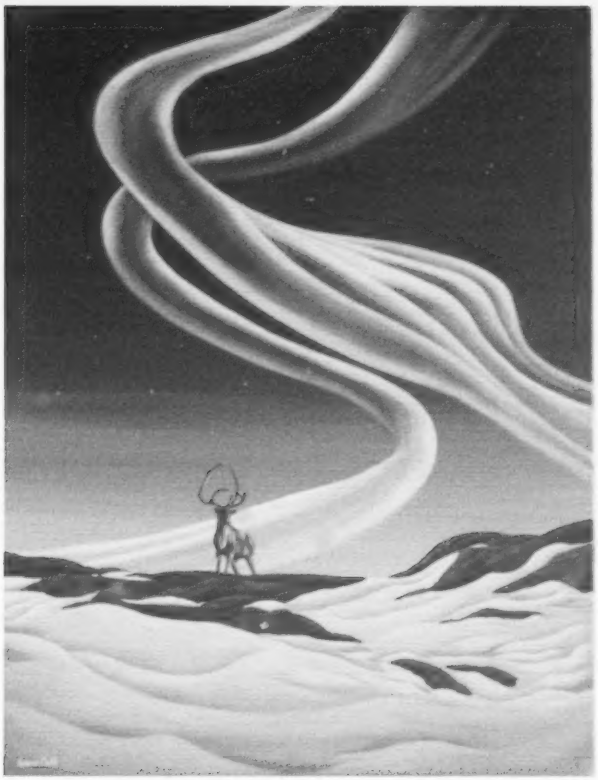
INTRODUCTION

A story from Danny Beaulieu: A long time ago, when caribou could speak, a bull caribou came down from the tundra. When he reached the treeline he saw a tent. The caribou was curious so he approached the tent. As he drew near, he could hear a woman crying inside. The caribou wanted to know what was wrong, so he changed himself into a man and entered the tent. He asked the woman why she was crying. The woman said that her whole tribe had died and all that was left was her and the children; they were all alone. The caribou said that he would stay and live with her and help her build up her people and teach them how to live. But there were two conditions: that nobody could hunt with him and that someday he would have to leave. So the caribou stayed with her and over time her people became strong again and learned how to hunt. Then the day came when the caribou told the woman that he had to leave. She accepted what he said and he left in the night. But the woman changed her mind and decided to follow him to try to bring him back. She followed his tracks down to the ice. When they reached the ice, the tracks changed to hoof prints and went off across the lake.

"We are the descendants of the caribou. The caribou once helped our people to recover – now it's our turn to help them." Danny Beaulieu



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The Bathurst caribou herd declined rapidly from 2003 to 2009 to a population of about 31,900, based on a survey in June 2009 on the calving grounds. Although caribou populations increase and decrease according to natural cycles, the decline since 1996 had accelerated steeply in recent years suggesting that management actions needed to be taken swiftly to give the Bathurst caribou herd the best chance to recover.

The Bathurst herd has economic and cultural importance to many northern communities. Two communities in Nunavut harvest the herd when the herd is nearby during spring migrations or after calving. Communities in the Tłı̨chǫ and North Slave region harvest the herd in the fall and particularly in winter when the herd is on its wintering grounds. Aboriginal hunters from the South Slave and Dehcho regions harvest Bathurst caribou during the winter when their wintering grounds are accessible by ice road. The Aboriginal harvest is not well documented and varies from year to year.

From 2006 to 2009, resident hunters could harvest up to two barren-ground bull caribou each year. Non-resident hunters could harvest up to two bull caribou per year but had to use the services of a licensed outfitter. In the Inuvialuit, Gwich'in and Sahtu Settlement Areas, resident and outfitted hunting was closed in 2007 in response to declines in other herds.

Because of the low numbers recorded during the 2009 Bathurst survey and the herd's rapid decline, ENR held two workshops over four days, October 1 and 2, and 5 and 6, 2009, to review the information on this decline and consider management actions. As the two workshops were similar and were organized to discuss the same issues, they are treated as one workshop for this report. Participants were representatives of communities and groups with an interest in the Bathurst caribou herd.

Seasonal Ranges and Communities of the Bathurst Caribou Herd

The Bathurst herd's calving grounds have been southwest of Bathurst Inlet (in Nunavut) since 1996. The summer range was mostly north of the treeline on the tundra, and had three active diamond mines (Ekati, Diavik and Snap Lake) in 2009. Most of the hunter harvest was in winter when the herd was accessible by all-weather and winter roads. In some winters collared Bathurst caribou ranged into northern Saskatchewan.

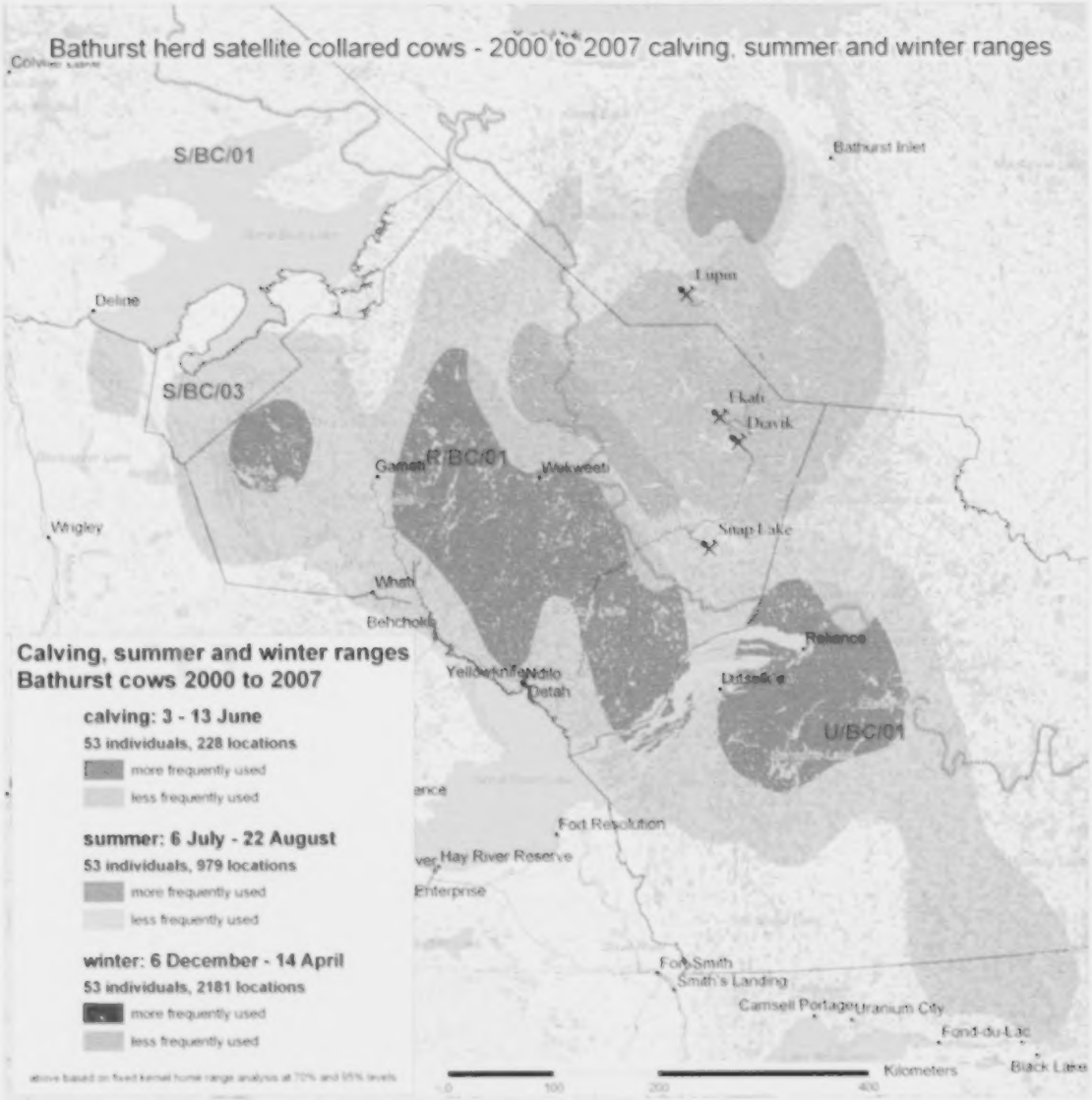


Figure 1. The combined calving, summer and winter ranges of the Bathurst caribou herd include nearly 350,000 km^2, based on satellite radio collar locations from 2000 to 2007. (Map by A. D'Hont, ENR)

(Photo credit: Archana Bali)

Goals and Objectives of the Workshops

The goals of the workshop were to review the critical decline in the Bathurst herd and to discuss possible management options for recovery. The discussions during the workshop were considered in the development of a joint caribou management proposal by ENR and the Tłı̨chǫ Government to the Wek'èezhìi Renewable Resources Board (WRRB) in November 2009.

The objectives of the workshop were to:

i) Share information on the status of the Bathurst caribou herd and other herds;

ii) Discuss factors that may be contributing to the decline of the Bathurst herd; and

iii) Consider management options to prevent further declines, including harvest management.

Early October 2009 Bathurst Caribou Workshops – Where Do They Fit In?

The Bathurst caribou range covers a vast range, with its calving ground and part of its summer range in Nunavut, a large part of its summer, fall and winter range in the NWT, and occasionally a portion of its winter range in Saskatchewan. Management of the herd must take into account all this range and the various jurisdictions within which the range falls.

Within the North Slave region, the Tłı̨chǫ government implements the Tłı̨chǫ Agreement within the Tłı̨chǫ Settlement Area. The WRRB is the co-management board responsible for natural resource management within Wek'èezhìi, which is the majority of the settlement area.

The GNWT remains ultimately accountable for wildlife management in the NWT, and is responsible for consulting with the other communities and Aboriginal organizations, with and without settled land claims (e.g. Métis Nation, Lutselk'e, and Yellowknives Dene) that hunt the Bathurst caribou herd.

The Bathurst caribou workshops on October 1 and 2, and 5 and 6 were set up primarily to share information among all parties and discuss management options to assist in the recovery of the Bathurst caribou herd. There were meetings and other workshops in the Tłı̨chǫ and other communities after the June 2009 survey of the herd, and these would continue into winter. Representatives from all affected communities were invited to the workshops, as well as representatives from Nunavut and Saskatchewan.

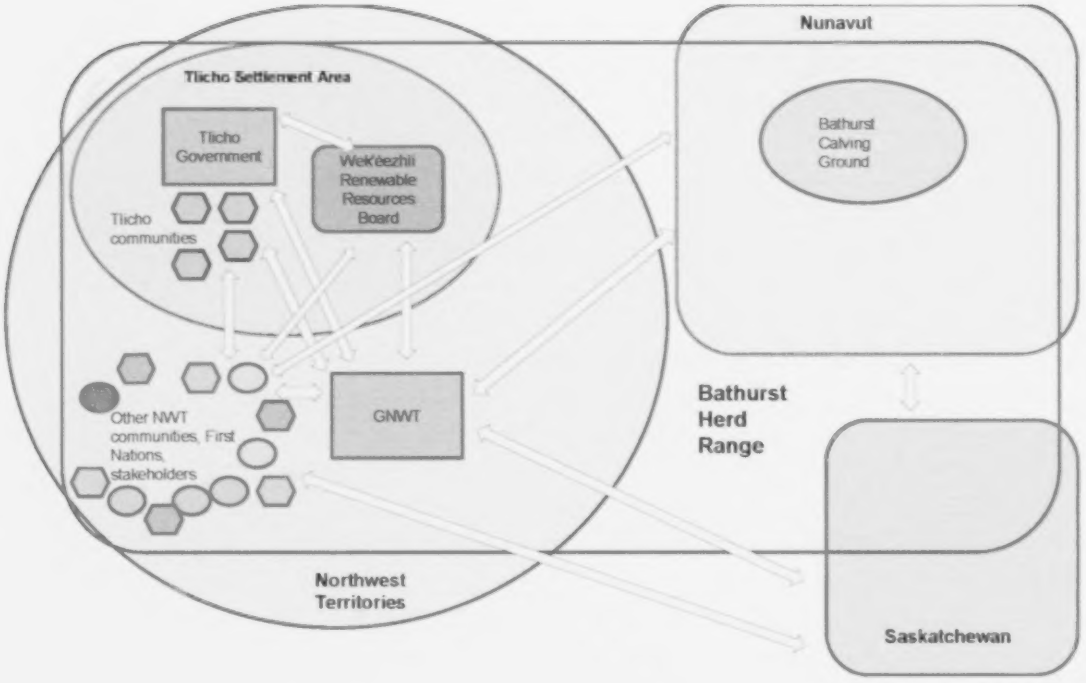


Figure 2. Bathurst caribou range, jurisdictions and communities: information-sharing workshops.

Bathurst Management Proposal, WRRB Hearings and Consultation

The diagram below (Figure 3) shows how management actions for the Bathurst herd were being developed in 2009.

1. The workshops described in this report were part of information sharing (meetings, workshops) between all parties in summer and fall 2009.
2. The WRRB asked the Tłı̨chǫ Government and GNWT to prepare a joint caribou management proposal in 2009.
3. GNWT would consult with other communities and stakeholders on the joint management proposal.
4. The WRRB would hold a hearing to obtain public input on the proposal, as required by the Tłı̨chǫ Agreement. All organizations and individuals could submit information and make presentations at this hearing.

5. The WRRB would then provide a set of management recommendations to both the Tłı̨chǫ Government and GNWT. The GNWT and Tłı̨chǫ Government would then consult on the implementation of these recommendations. The GNWT had a responsibility to consult with all affected parties in the Bathurst range.

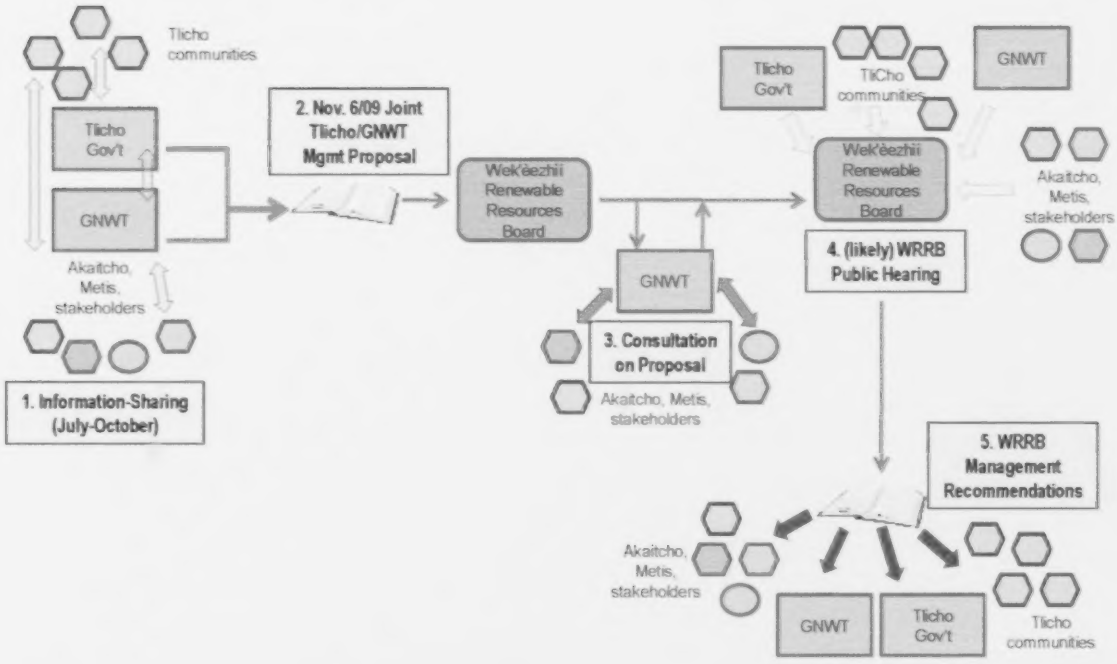


Figure 3. Development of Bathurst caribou management actions in 2009.

STATUS OF CARIBOU HERDS AND CARIBOU CYCLES

Status of NWT/Nunavut Barren-ground Caribou Herds

The workshop began with a review of the status of the NWT barren-ground caribou herds. The ranges (Figure 4) are based on accumulated radio collar locations for each herd over time. A computer program was used to draw outside boundaries for each herd's range. The calving ground for each herd is the solid shape at the north end of the range. Herds are defined based on the fidelity of cows to calving grounds. Collared cows typically return to the same calving ground 96-98% of the time.

Figure 4 includes population estimates for each herd between 1985 and 2008 and for two herds not on this map – the Porcupine range to the west and the Qamanirjuaq herd to the east. All the herds in Figure 4 showed declines in recent years (2000-2009), some more rapidly than others. The greatest decline happened in the Beverly herd, with extremely low numbers found in 2007, 2008 and 2009, and limited evidence of radio collared cows shifting to the calving grounds of the Ahiak herd to the north. The few radio collared Beverly cows appeared to be mixed with the much more numerous Ahiak caribou since 2007. A population survey of the Ahiak caribou has not been done but was planned for June 2010 as a joint effort between Nunavut and NWT.

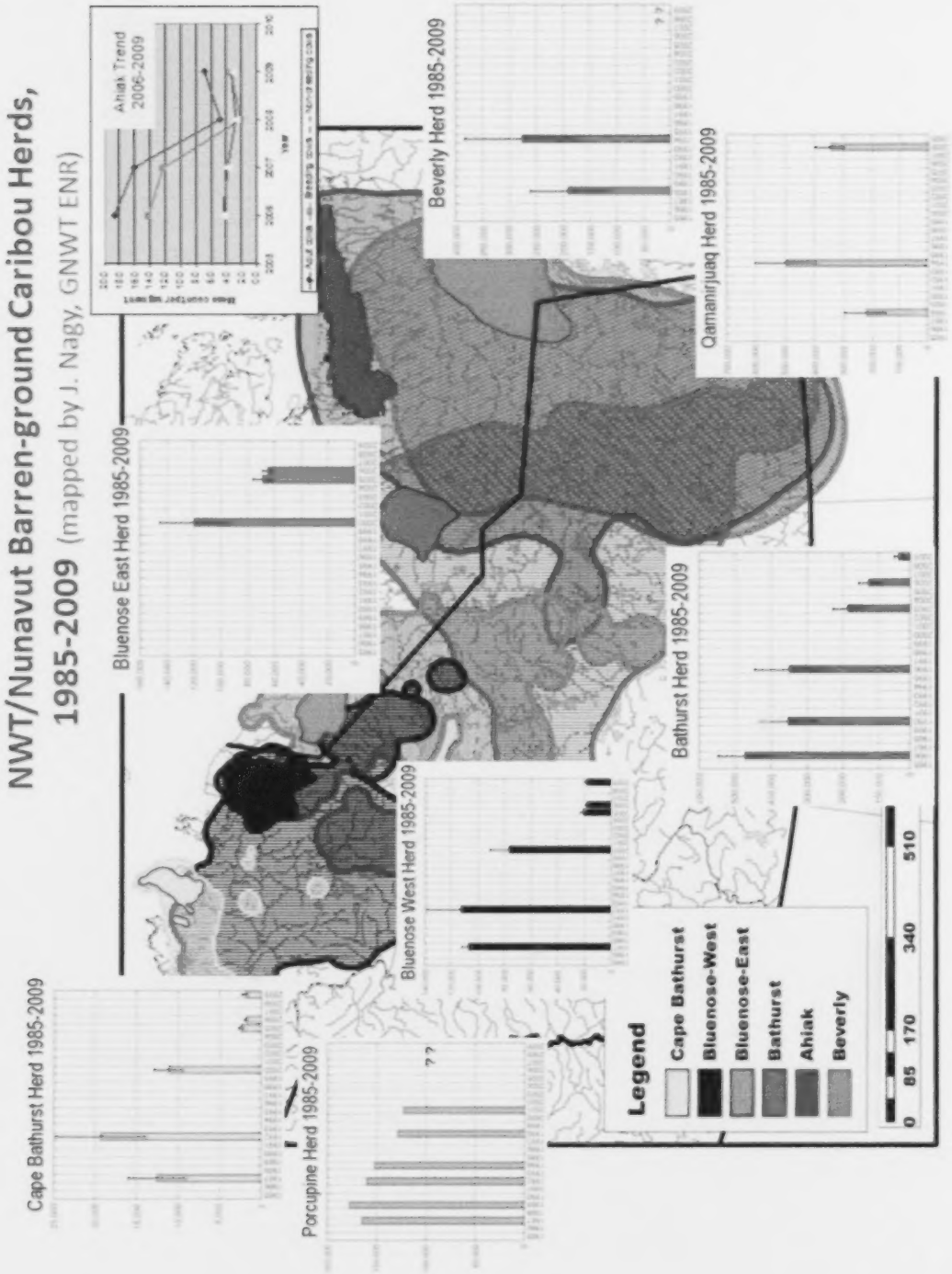


Figure 4. Annual ranges of six caribou herds in the NWT and Nunavut. (Map by J. Nagy, ENR)

Cycles in Caribou Numbers – Traditional Knowledge

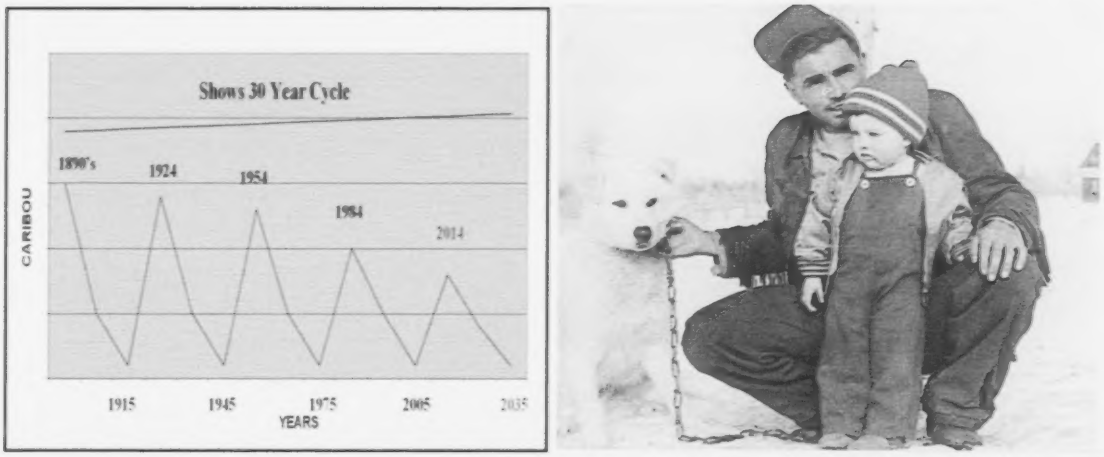


Figure 5: 30 year cycle in caribou numbers. (Graph and photo: D. Beaulieu)

Danny Beaulieu gave a presentation on caribou population cycles during the past 120 years, using TK from Chipewyan elders to recreate times when caribou were abundant and when they were scarce. The Bathurst caribou herd has been increasing and decreasing in size on a cycle of about thirty years. However, it seems that the population peaks reached by the herd were gradually decreasing. Beaulieu discussed the role of new technologies in the decline of the Bathurst herd. He noted that in the past, when the caribou population declined, it was difficult for hunters to find the herd. Hunters walked or traveled by dog-team. Communities used alternative sources of meat and the caribou herd was given time to recover from low numbers. Hunters in 2009 used fast snowmobiles, trucks and airplanes. They had easy access to the herd along the winter roads. In 2009, hunters could always find the herd because they had the ability to travel long distances in search of caribou. The harvest pressure on the herd had thus increased in recent years and was likely a factor in the steep decline in the herd. If hunting was not decreased, the next peak might be very low.

(Photo credit: D. Beaulieu)

(Photo credit: Archana Bali)

Cycles in Caribou Numbers – The George River Herd, Quebec/Labrador

Long-time caribou biologist Tom Bergerud used a variety of methods to re-construct periods of high and low numbers in the George River herd in Quebec/Labrador. Surveys began around 1960 when the herd was estimated at 5,000. The herd then grew to about 700,000 in the early 1990s and had been decreasing since then. Bergerud used various sources of information: knowledge of the Innu and Inuit people of this region, trading post records, and records from river crossings where people hunted caribou. In earlier days there were periods of starvation when hunters could not find caribou.

Biologists in Quebec found that the roots of old spruce trees along caribou migration trails would show scars from caribou hooves on annual tree growth rings. In years when there were many caribou, they found many scars on the spruce roots in that year's ring. Over the period for which there was survey information, they found that spruce root scars tracked the overall herd's numbers. With very old trees, they could then go back to about 1800 and estimate periods of low and high numbers in this caribou herd. This added to the other information from Innu and Inuit people.

The re-construction of the George River herd's numbers indicated that this herd has gone through large changes in numbers several times over 200 years. Sometimes the herd

declined to low numbers, and did not recover for quite a few years. The cycles did not always have the same length, the peaks were not always as high, and the low points also varied.

Information from TK, government surveys and other sources all tell us that barren-ground caribou have gone through big changes in numbers for a long time. Conditions for neighbouring herds are not always the same: while the George River herd declined in the 1990s and 2000s, its neighbour the Leaf River herd was increasing.

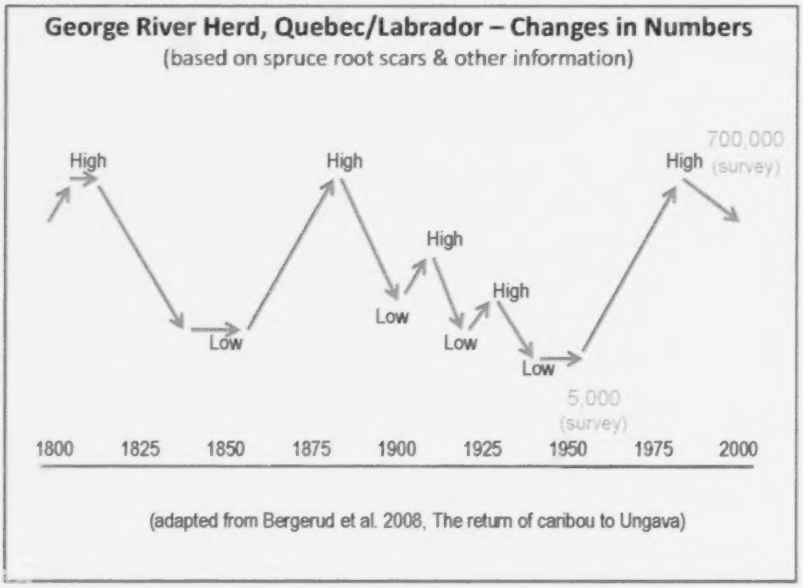


Figure 6: Changes in the population numbers of the George River Herd, Quebec and Labrador. (Reference: Bergerud et al. 2008.)

Decline in the Beverly Herd – The Dangers of Reaching Very Low Numbers

It is worth looking at the decline of the Beverly herd, a herd once estimated at 276,000 in 1994. Our understanding of what happened to this herd is limited because there were no surveys between 1994 and 2002, and there were almost no radio collars on this herd until 2006.

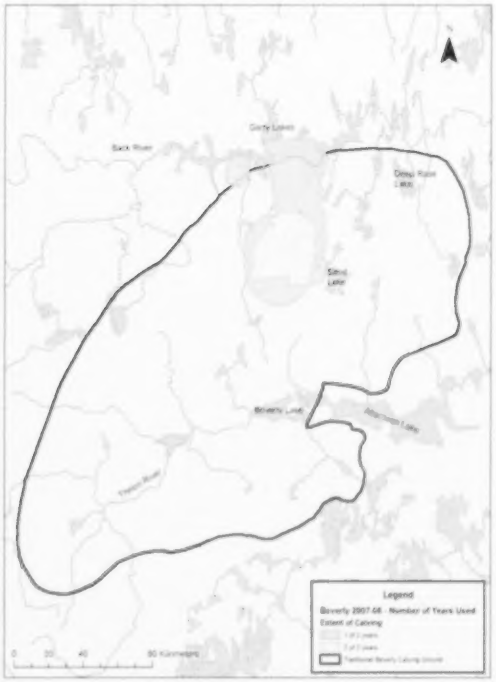


Figure 7. Beverly traditional calving ground (outline) and area used in 2007-2008.

We can look at the numbers of caribou seen during systematic reconnaissance surveys on the calving grounds. These are visual surveys where observers record every caribou they see along flight lines 10 km apart. These surveys are not meant to give a precise population estimate, but because the methods were consistent, they can give an index of caribou numbers on the calving grounds over time.

The last full population survey for the Beverly herd was in June 1994, when the herd was estimated at 276,000. That year about 5,700 caribou (excluding newborn calves) were seen on the systematic reconnaissance survey. Less than half that number was seen eight years later in 2002. Surveys in 2007, 2008 and 2009 showed that the number of cows using this calving ground was at most 1% of the number in 1994 and indicated a catastrophic decline from 2002 to 2007. In addition, very few calves were seen on the Beverly calving ground, and radio collared Beverly cows had exceptionally high mortality rates. There was limited evidence from radio collared Beverly cows of a shift to the calving grounds of the much larger Ahiak herd to the

north. Outside of the calving period, the few remaining Beverly collared cows were mixed with Ahiak caribou and no longer had their own separate seasonal ranges.

We will likely never fully know what happened to the Beverly herd, but we should recognize that caribou declines may not always be followed by increases. Unpredictable things can happen if caribou herds reach very low numbers.

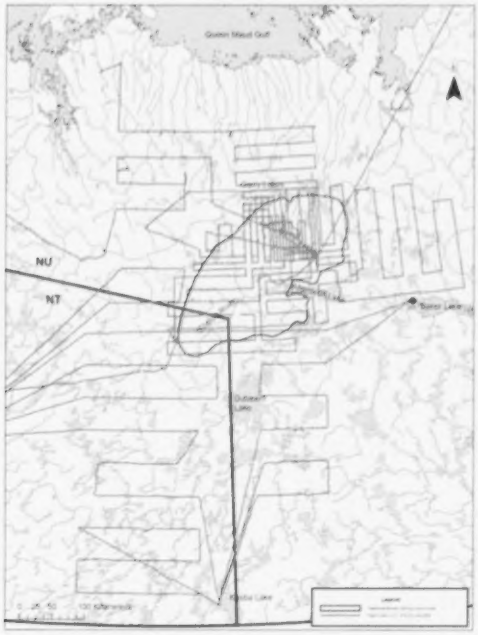


Figure 8. Aerial flight lines June 4-18, 2008 over the Beverly calving ground. Two aircraft were used.

FACTORS AFFECTING NUMBERS OF BARREN-GROUND CARIBOU

We know that barren-ground caribou herds go through cycles or large changes in numbers, but the cycles are complex. Two neighbouring herds will not always have the same population trend and the same conditions affecting them. As noted earlier, the George River herd declined over the 1990s and 2000s while its neighbour in Labrador, the Leaf River herd, was increasing. Participants at the workshops raised a number of issues that could be contributing to the decline of the Bathurst herd and other caribou herds. This section of the report presents some of the material used at the workshops, and a summary of key points from participants.

Weather, Green-Up and the Plants Caribou Eat

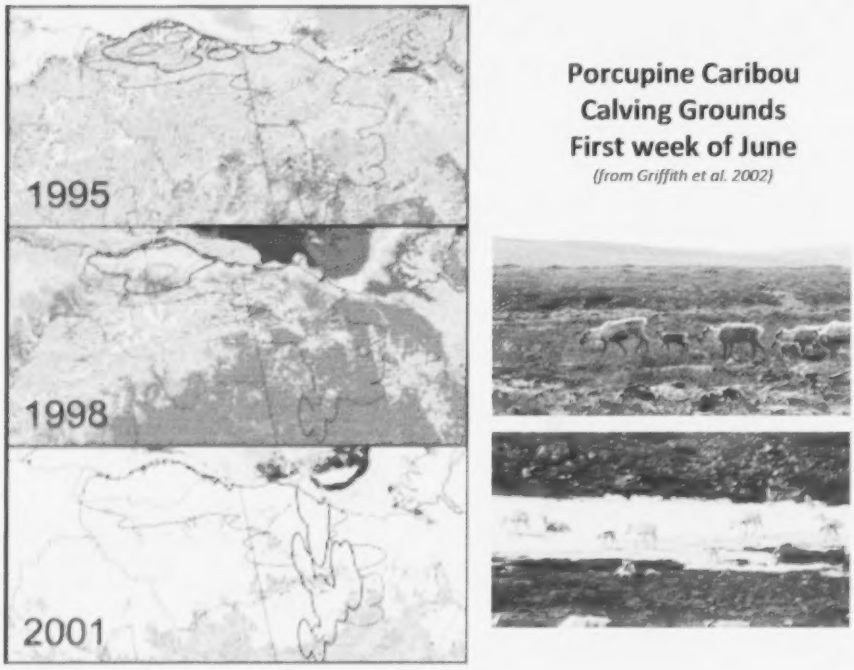


Figure 9: Porcupine caribou calving grounds during the first week of June – 1995, 1998, and 2001. (Griffith et al. 2002)

The three maps above are images of the Porcupine Herd's calving grounds on the Alaskan North Slope (Griffith et al. 2002). Each of them was taken by a satellite in the first week of June when most of the calves in this herd are born. When spring came early, as in 1998, the snow had melted and there was abundant fresh green food for cows nursing calves. The coastal calving ground also has fewer predators than areas to the south. In such years summer calf survival was good. In other years, as in 2001, the preferred coastal calving grounds were still under snow and cows gave birth in the mountains while still on the spring migration. In such years summer calf survival was poor.

This study illustrates one way in which weather can affect caribou: many years with a late spring could result in a decline. Weather can also affect growth and quality of the plants that caribou eat in the summer, hot weather can result in interference in feeding from insects, and fire on the winter range may burn the slow-growing lichens caribou eat in the winter. Deep hard snow and ice layers in the snow can make it difficult for caribou to feed in the winter. We can study these patterns but we have little control over the weather.

Hunter Harvest

Hunter harvest was discussed more than other factors affecting caribou because human impacts on caribou can be managed, and because the hunter harvest can have major impacts on declining caribou, especially at low numbers. Several people, including Danny Beaulieu, spoke about how different hunting was today compared to earlier times. The table that follows was compiled at an earlier workshop in May 2009, where several Aboriginal leaders, including Walter Bayha and Joe Rabesca, spoke on this subject. Overall, their comments showed that many hunters continue to hunt in respectful ways and take only what they need. However, some hunters, particularly younger hunters, have at times used practices less respectful of caribou. It has also become much easier to hunt caribou, even at very low numbers, because of additional roads, pickup trucks and high-powered skidoos.

Table 1. A comparison of hunting by traditional ways and some of the more recent changes in hunting practices (2009) and their implications for caribou harvest[1].

Traditional hunting	Current hunting
Done with snowshoes / dog-team / slower snowmobiles with small wooden toboggans	Fast, wide track snowmobiles with large teflon and fiberglass toboggans. People even hunt from trucks and vans on the winter roads.
Good organization / Community / Social event	Many small groups / often strangers
Open scope. Less accuracy. Fewer animals taken	High powered rifles with scopes – shoot from a distance; shoot many quickly
Taking your time	Done quickly
Part of the lifestyle	Done for sport
Selecting healthy animals from herd	No selection of healthy animals
Leaving most of group / herd alive	Killing all of a group
Letting the leaders pass	Killing the first animals through
Conservation education built into lifestyle	No awareness of conservation ethic
Selecting sex based on use/need	Killing indiscriminately
Taking only what was needed	Killing more than is needed
Sharing meat	Selling meat. Stories of dump trucks coming from other communities to take caribou away
Using all of the animal	Wasting meat
Taking elders along	Not practiced as much now
Asking permission to use the land	People coming from everywhere
Easy to track how many animals taken	Very difficult to track number of animals taken
Leaving the bones / remains to rest on the land	Carcasses at the dump or left on ice roads
Caribou weren't always accessible. Successful harvest depended on their migration route	Hunters access caribou wherever they are – regardless of migration pattern. Airplanes, roads, fast snowmachines, etc.
People lived with / followed caribou population cycles - harvest decreased when numbers were low	Even during low population cycles, harvest stays high because people can always access the animals.

(Photo credit: D. Beaulieu)

[1] Inclusion of these observations from Oct. 2009 workshop participants does not imply a general comment on NWT caribou hunters in 2009. Most NWT hunters continue to use sound practices respectful of caribou. Workshop participants noted that changes in technology, access and poor practices by some hunters had contributed to large caribou harvests.

Tree Line
Ulu
Izok
Ekati
Diavik
30 km radius around the mines
Summary of area used during calving, post-calving and summer migration of caribou between 1996 - 2005 based on movement of Bathurst collared animals.

Figure 10. Areas used during calving, post-calving and summer migration of Bathurst caribou 1996-2005 based on movement of collared caribou. The map above shows the calving (green), post-calving (purple) and summer (yellow) ranges of the Bathurst herd, based on radio collar caribou locations from 1996 to 2005. Darker areas had greater use by caribou. The Ekati and Diavik diamond mines are in the summer range and the Snap Lake mine is on the edge of the summer range. (Map by B. Croft, ENR)

Studies of the effects of the diamond mines on Bathurst caribou, based on collars and aerial surveys within 30 km of the mines, have confirmed that there was partial avoidance by caribou to a distance of 15-23 km from each active mine. Dust and noise (e.g. blasting) may account for this reduced use by caribou. However, this only affected about 3-4% of the current summer range. Caribou that come near the mine may also be disturbed by traffic, but numbers of caribou seen near the mines have tended to be low. Overall, these studies suggest that the diamond mines have had some effects on caribou, but to date the effects have been limited and were not the main driver in the herd's decline.

Most workshop participants felt that exploration and mining have had negative effects on the Bathurst caribou herd. Several participants expressed their concern about helicopters used during exploration, about the many transport trucks servicing the mine along the ice road, and that blasting at the mine site could cause contamination in the surrounding areas. The ice roads also provide more access in winter for hunters to the Bathurst winter range. Participants agreed that caribou avoid the mines and that further research is needed to understand the effects of mining and exploration on caribou. Several participants spoke about the need to protect calving grounds in NWT and Nunavut. To date (2009) there has not been any exploration or development activity on the Bathurst calving ground.

Wolves and Other Predators

Bruno Croft presented the Figure 8 with information about annual surveys of wolf dens at the south end of the Bathurst summer range. Biologist Dean Cluff (ENR) has collected this information annually since 1996. Over the last five years (2005-2009) the number of wolf dens actively being used in August dropped from 17 to 1. On the June 2009 Bathurst calving ground survey, there were a total of four wolf sightings and eight bear sightings in about 15,000 km of survey flight lines. Overall, this information suggested that wolf numbers dropped as the Bathurst herd declined. Similar patterns were noted by biologist Tom Bergerud during the George River herd's period of low numbers in the 1940s; with no other prey to rely on, wolves essentially disappeared in this herd's range in Quebec/Labrador (Bergerud et al. 2008).

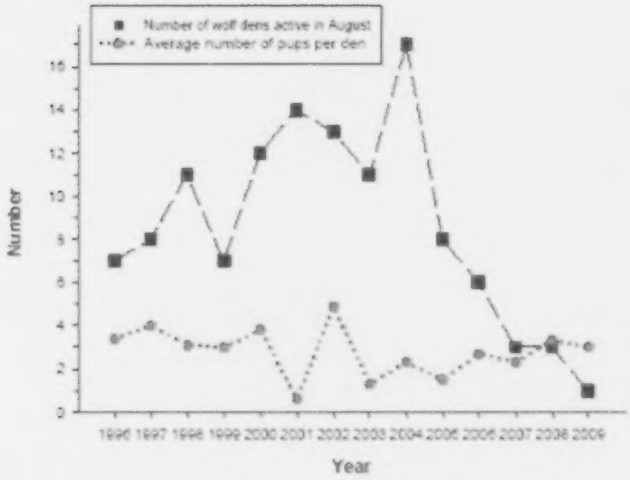


Figure 11. Average pup counts for wolf den sites active in August on the central Arctic tundra, Northwest Territories (graph by D. Cluff, ENR).

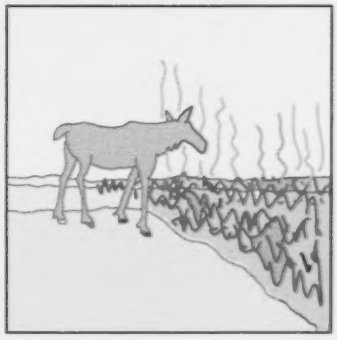
Some workshop participants were concerned that given the small caribou population size, predation by wolves and bears could have a strong negative impact on the Bathurst herd. They suggested that measures be taken to control the wolf population, particularly along the treeline. Other participants supported the conservation of wolves as being part of nature, given that wolf numbers have declined in response to the decline of the caribou herd. They believed that wolf population control was unnecessary and generally ineffectual. Participants did not reach consensus on the management of predation by wolves.

(Photo credits: Archana Bali)

Fire on the Winter Range

Figure 12. Map showing fire history in the North Slave region 1965-2008 (map provided by L. Schmidt, ENR); darker colours are from more recent years.

Relationships between caribou and fire on their forested winter range are complex. Fire is a normal part of the boreal forest ecosystem, and caribou have co-existed with fire for a long time. Some fires burn everything down to the mineral soil; others leave wetter areas unburned and extensive islands of unburned forest may be left in some burns. Caribou generally use regenerating burns little until they are at least 50-60 years old, because the lichens they eat in winter are very slow-growing. Complete fire suppression on a large landscape will never be practical in the NWT. In some southern regions, prolonged fire suppression may be counter-productive because fuel build-up encourages very large fires that may be difficult to stop.



Several workshop participants expressed their concern that large wildfires in recent years have destroyed areas of important caribou winter habitat, particularly east and south of Great Slave Lake. They suggested that the remaining corridors of habitat through burned areas be given increased fire protection to allow the caribou to move through the landscape during their migration and to feed in during winter. Other participants felt that fire was a natural part of the landscape and that controlling fire across the range could lead to large, more destructive fires due to fuel loading. Workshop participants did not reach consensus on the management of fire, but most participants felt that key caribou winter ranges should be protected. Ernie Campbell explained that ENR's fire program was due for review and that there would be community meetings in which people could participate.

DECLINES & HUNTER HARVEST IN THREE NWT CARIBOU HERDS

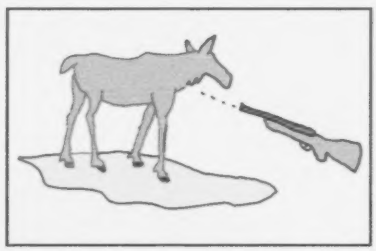
Three NWT barren-ground caribou herds have experienced similar declines in recent years, and comparisons between the herds show the significance of hunter harvest and harvest management. The Cape Bathurst, Bluenose-West and Bathurst herds all declined relatively slowly, and then declined at an accelerated rate as their numbers came down.

The Cape Bathurst herd declined at about 4%/year from 1992 to 2000, then at a rate of 14%/year from 2000 to 2006.

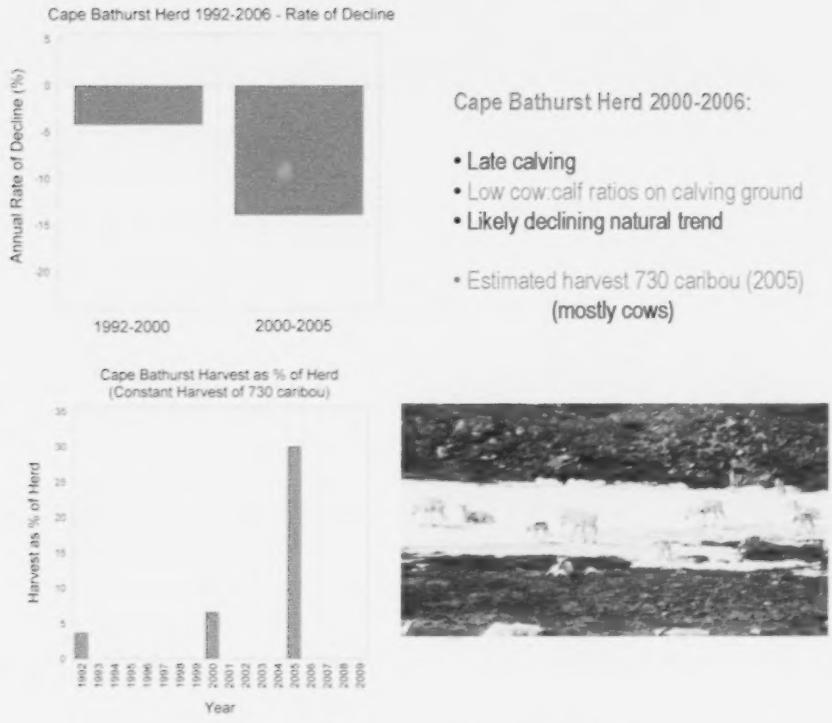
The Bluenose-West herd similarly declined by about 4% per year from 1992 to 2000, then at a faster 13% per year from 2000 to 2006.

The Bathurst herd declined at about 5% per year from 1996 to 2006, then by 22-23% per year from 2006 to 2009.

In the next pages the declines of these three herds are considered in more detail.



Decline and Harvest Management in the Cape Bathurst Herd


Cape Bathurst Herd 1992-2006 - Rate of Decline
Annual Rate of Decline (%)
1992-2000
2000-2005
Cape Bathurst Herd 2000-2006:
• Late calving
• Low cow:calf ratios on calving ground
• Likely declining natural trend
• Estimated harvest 730 caribou (2005)
(mostly cows)
Cape Bathurst Harvest as % of Herd
(Constant Harvest of 730 caribou)
Harvest as % of Herd
Year

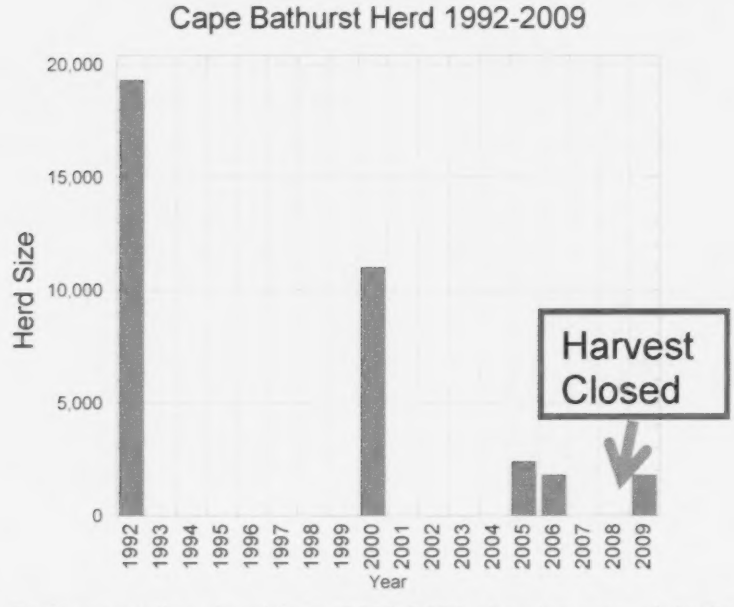


Figure 13: Cape Bathurst caribou herd from 2000-2006 showing rate of decline, percentage of herd harvest and herd population size.

In the early 2000s, late calving and low calf:cow ratios were recorded on the calving grounds of the Cape Bathurst herd. These observations would indicate that the caribou were nutritionally limited, and likely would have been declining naturally without hunting. The estimated hunter harvest for the Cape Bathurst herd was around 730 caribou in 2005 (primarily cows). If this harvest was about the same in earlier years, then 730 caribou would be about 3% of the herd in 1992, about 7% in 2000, and about 30% in 2005. No caribou herd could survive long at this level of harvest (30%), especially if it was already declining. By recommendation of the Wildlife Management Advisory Council (NWT) (WMAC-NWT) and implemented by GNWT, all harvest on this herd was closed in 2007. A July 2009 survey of this herd indicated a reduced but stable trend from 2006 to 2009. This result suggests that the harvest contributed significantly to the herd's earlier decline. Better calf recruitment also contributed to the herd's stabilization.

Decline and Harvest Management in the Bluenose-West Herd

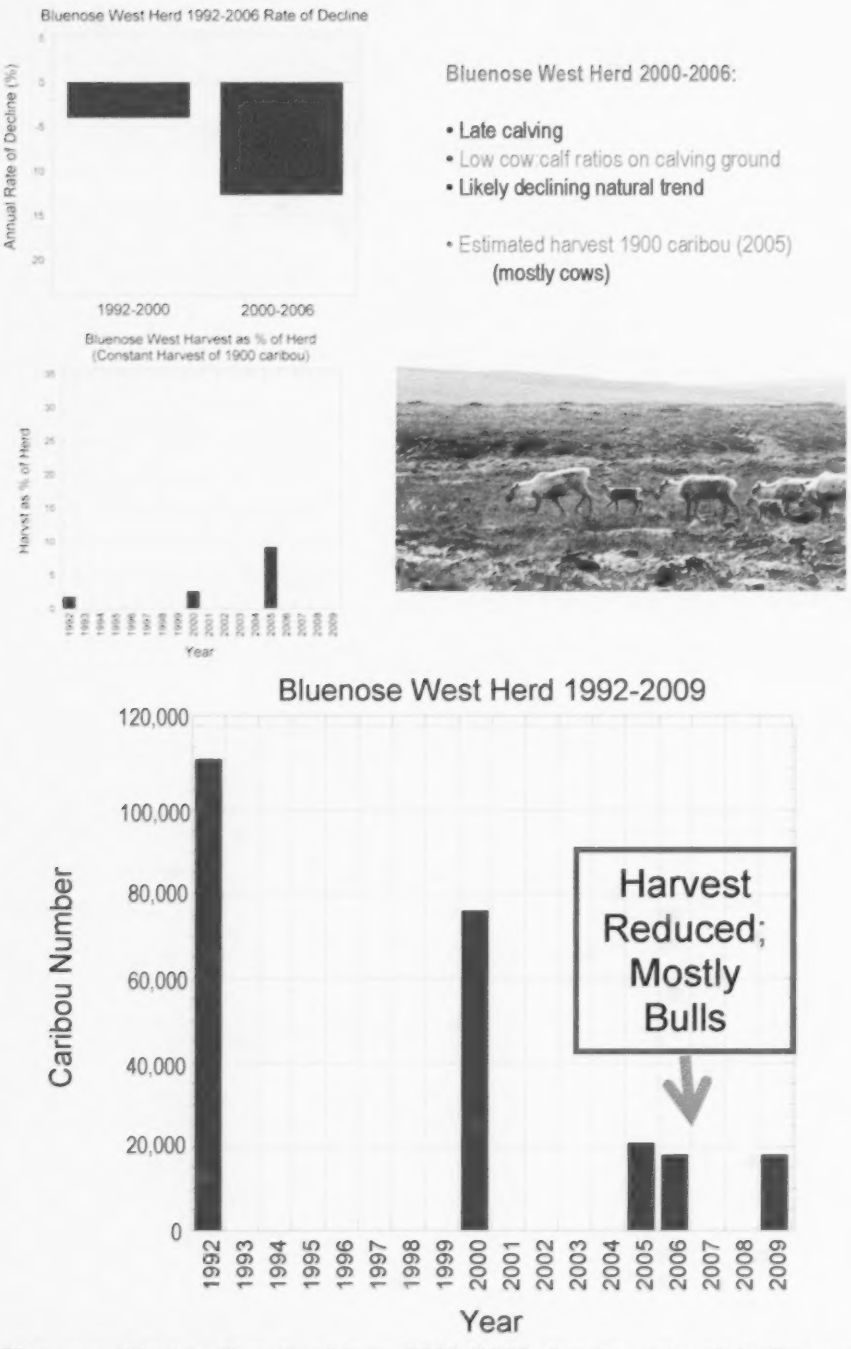


Figure 14: Bluenose-West caribou herd from 2000-2006 showing rate of decline, percentage of herd harvest and herd population size.

Patterns of decline in the Bluenose-West herd in the early 2000s were similar to those in the Cape Bathurst herd. Late calving and low cow:calf ratios on the calving ground indicated that the caribou were nutritionally limited, and likely would have been declining naturally without hunting. The estimated hunter harvest for the Bluenose-West herd was around 1,900 caribou in 2005 (primarily cows). If this harvest was about the same in earlier years, then this harvest would be about 2% of the herd in 1992, about 3% in 2000, and about 9% in 2005. Evaluation of the decline by Craig Nicolson (University of Massachusetts) suggested that the harvest may have been higher than 1,900/year in the 2000s. By recommendation of WMAC-NWT and the Gwich'in and Sahtu Renewable Resource Boards, a total allowable harvest was set at 720 caribou (4% of the herd), with at least 80% bulls in 2007. A July 2009 survey of this herd indicated a stable trend from 2006 to 2009. As with the Cape Bathurst herd, this change suggests that the harvest had contributed significantly to the decline in the early 2000s. Improved calf recruitment also contributed to the herd's stabilization.

Decline and Harvest in the Bathurst Herd

An evaluation of the decline of the Bathurst herd showed similarities to the declines of the Cape Bathurst and Bluenose-West herds. Between 1996 and 2006 the herd declined at an average rate of 5% per year. After 2006 the herd declined at a very high 22-23% per year. Spring calf:cow ratios in the early 2000s were low, indicating that the herd was most likely nutritionally limited and would have declined naturally, without hunting, over this period.

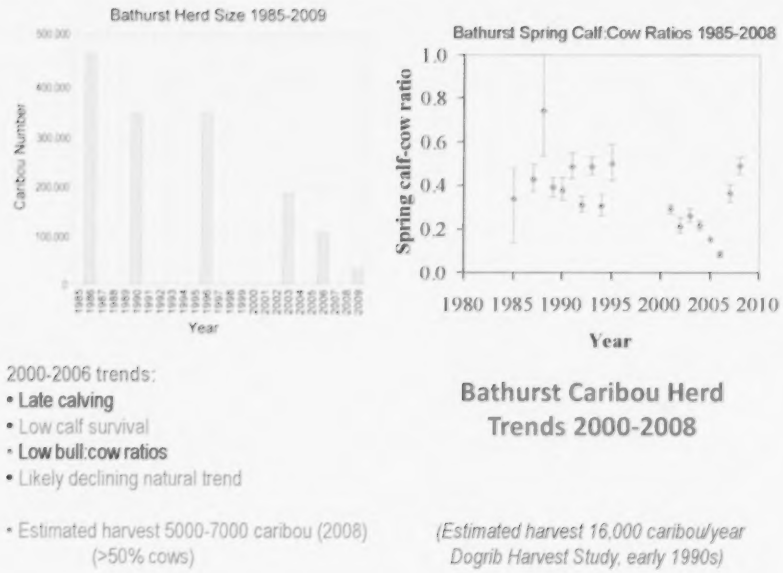


Figure 15: Trends in the Bathurst caribou herd size from 1985-2009; spring calf:cow rations from 1985-2008.

The hunter harvest has not been well documented for the Bathurst herd, but an estimate of 7,000 caribou/year is well below the 16,000/year for this herd estimated by the Dogrib Harvest Study in the early 1990s. As with the other two herds, a harvest of 7,000 would have been barely 2% of the herd in 1996, increasing to 4% in 2003, 7% in 2006, and 22% in 2009. A lower harvest of 5,000 caribou produces a similar result, with 15.6% of the herd taken in 2009. The winter harvest was mostly cows and the fall harvest was mostly bulls, and likely varied somewhat from year to year.

The Bathurst herd has been hunted by more communities in the NWT than any other. With winter roads have come increased access and greater hunter numbers. No caribou herd could withstand a harvest of 15-22% per year (mostly cows) for any amount of time.

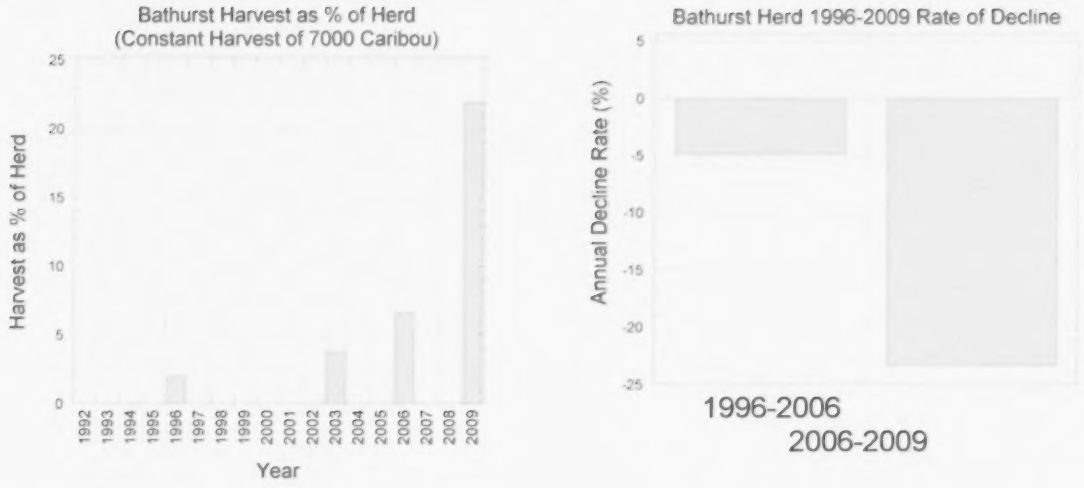


Figure 16: Percentage of the Bathurst caribou herd from 1992-2009 and the rate of decline from 1996-2006 and 2006-2009.

HARVEST MANAGEMENT FOR THE PORCUPINE CARIBOU HERD

Joe Tetlichi, chair of the Porcupine Caribou Management Board (PCMB), gave a presentation on the experiences of the PCMB in managing the Porcupine Caribou Herd. The PCMB is a co-management board made up of representatives from the Gwich'in Tribal Council, Council of Yukon First Nations, Inuvialuit Game Council, Government of the Yukon, GNWT, and Government of Canada. Recently, the PCMB has focused on protecting the calving grounds of the Porcupine herd in the Arctic National Wildlife Refuge and on managing hunting on the Dempster Highway.

Figure 17. Range of the Porcupine herd in Alaska, Yukon and NWT.

The PCMB recently completed a draft Harvest Management Plan for the Porcupine Herd and was working on a Native User Agreement among the various groups that use the herd. The Harvest Management Plan sets population ranges within which harvesting rules change and a minimum population size below which all harvest will be closed. The most important lesson learned by the PCMB during the development of the Harvest Management Plan is the need to

"walk together", to work collaboratively to conserve the caribou. The plan took about five years to complete.

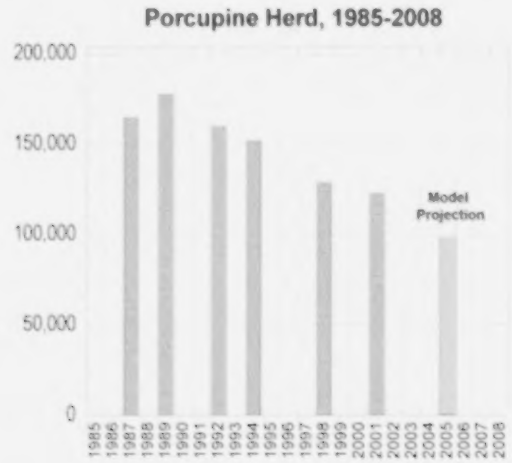


Figure 18: Porcupine caribou herd population ranges from 1985-2008.

The Porcupine Caribou Calculator and Harvest Management

The PCMB found that one of their management challenges was a lack of survey data. Poor weather conditions had prevented population surveys of the herd 2001-2008 (seven years in a row), but there was good information on harvest, calf:cow ratios, and other indicators. Craig Nicolson from the University of Massachusetts helped develop a "Caribou Calculator" to model population size and try to understand how various factors influence the population. This model is essentially a balance sheet where numbers of caribou added and lost every year are tracked. The calculator can be used to:

- Estimate likely herd size without a recent population survey;
- Look ahead to evaluate likely future trends of the herd;
- Consider how the size and sex ratio of the harvest is likely to affect the herd's future; and
- Identify areas where better information is needed.

(Photo credit: Archana Bali)

It is important to remember that this model cannot predict the future; it can only project what is likely to happen under a certain set of conditions. Unexpected weather effects, for example, can still occur, and these are unpredictable.

Figure 19: Porcupine caribou herd population survey results from 1983-2007 and population projections to 2020.

1. The first step with the model was to make sure it was faithful to the real world – the model produced the blue line (seen in the above graph) from 1983 to 2007, and the red dots were actual survey numbers. Thus the model fit the survey numbers well.

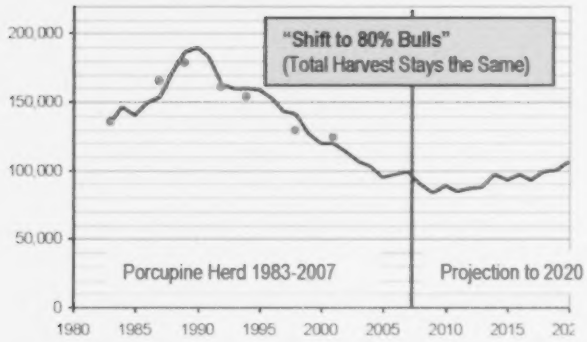


Figure 20: Porcupine caribou herd population survey results from 1983-2007 and 80% bull harvest projections on population status to 2020.

2. The next step was to project into the future: what happens if everything, including harvest, stays the same? The model indicated that a continued decline was likely. The harvest was estimated at 3,000 caribou/year, 61% of them cows.

3. The model was then used to ask "what if" questions. For example, the projection in the second graph shows what might happen if the number of harvested caribou stayed the same (3,000) but shifted to 80% bulls. The model suggested that this fairly simple change could help the herd stabilize.

4. One key point from the modeling was that population trend is highly sensitive to the rate at which cows die (mortality rate). Anything that increases their mortality rate, such as cow harvest, has a large impact on the herd.

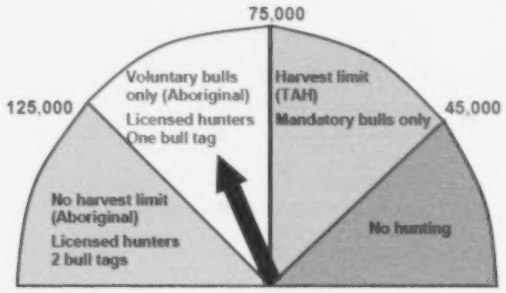


Figure 21: Porcupine caribou herd population harvest management model showing harvest restrictions in relation to population numbers.

5. The PCMB used the model to help develop the coloured zones (above) in their Harvest Management Plan.

- At high numbers (green), the harvest would be unrestricted.
- Below 125,000 (yellow), the harvest would be voluntary bulls only.
- Below 75,000 (orange) the harvest would be mandatory bulls only.
- Below 45,000 (red) all harvest would be closed to allow the herd to recover.

THE BATHURST CARIBOU CALCULATOR AND HARVEST MANAGEMENT

In 2007 a number of co-management boards recommended that ENR develop a population model for NWT herds. In 2008 and 2009, the GNWT contracted Craig Nicolson (University of Massachusetts) to adapt the Caribou Calculator developed for the Porcupine herd to the Bathurst herd, and to use it to look at possible futures for the herd. Nicolson used information on Bathurst calf survival, herd size, condition, pregnancy rate and harvest, and tried to project what the herd's trend might be over the next five years (2009-2014). Given the herd's recent rapid decline, it did not make sense to try to look ahead more than five years.

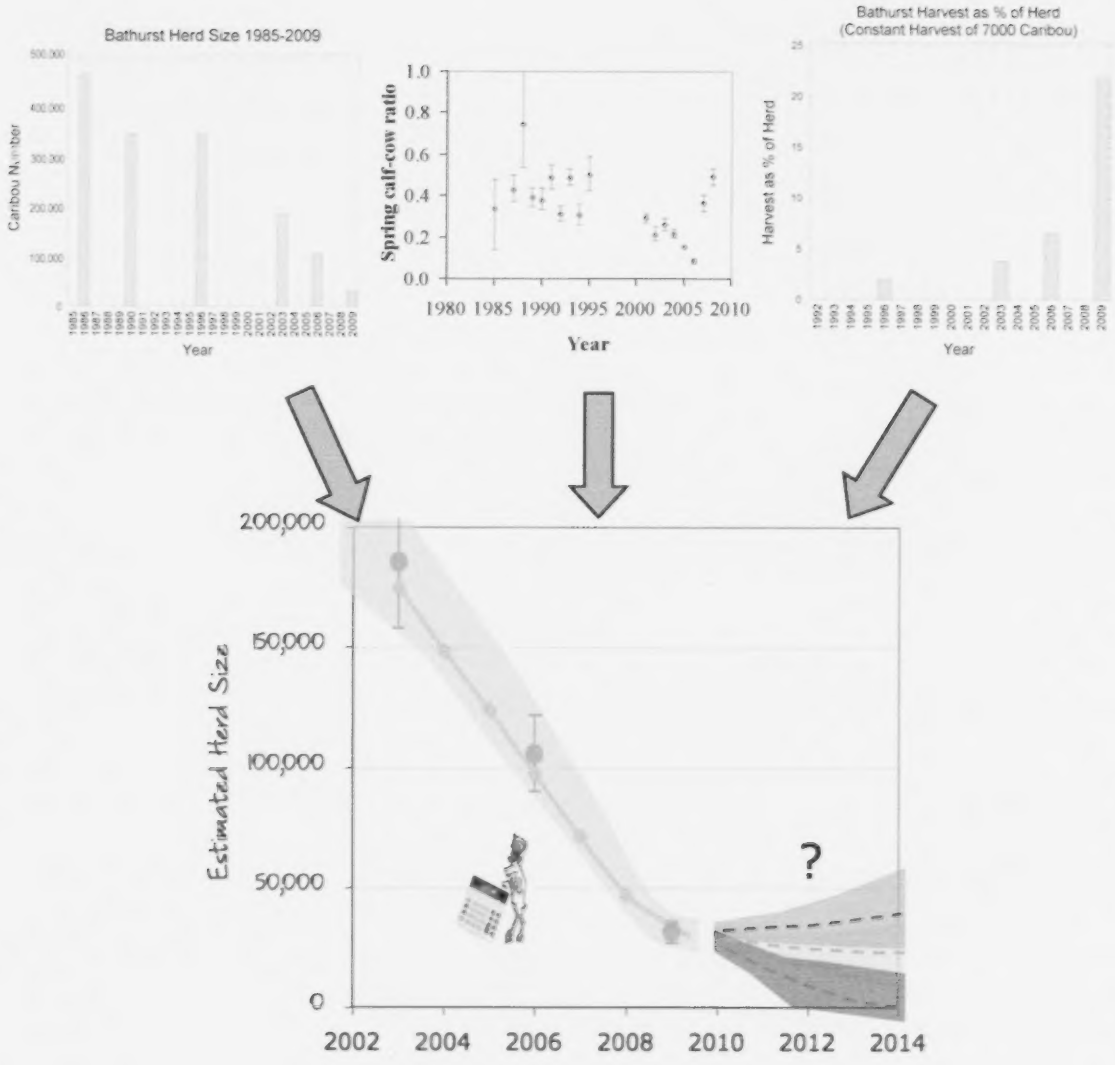


Figure 22. The Bathurst caribou calculator and harvest management.

Possible Futures for the Bathurst Herd

The graphs on this page were generated from the Bathurst Caribou Calculator. They are not exact predictions, but they give some idea of likely trends under various sets of conditions.

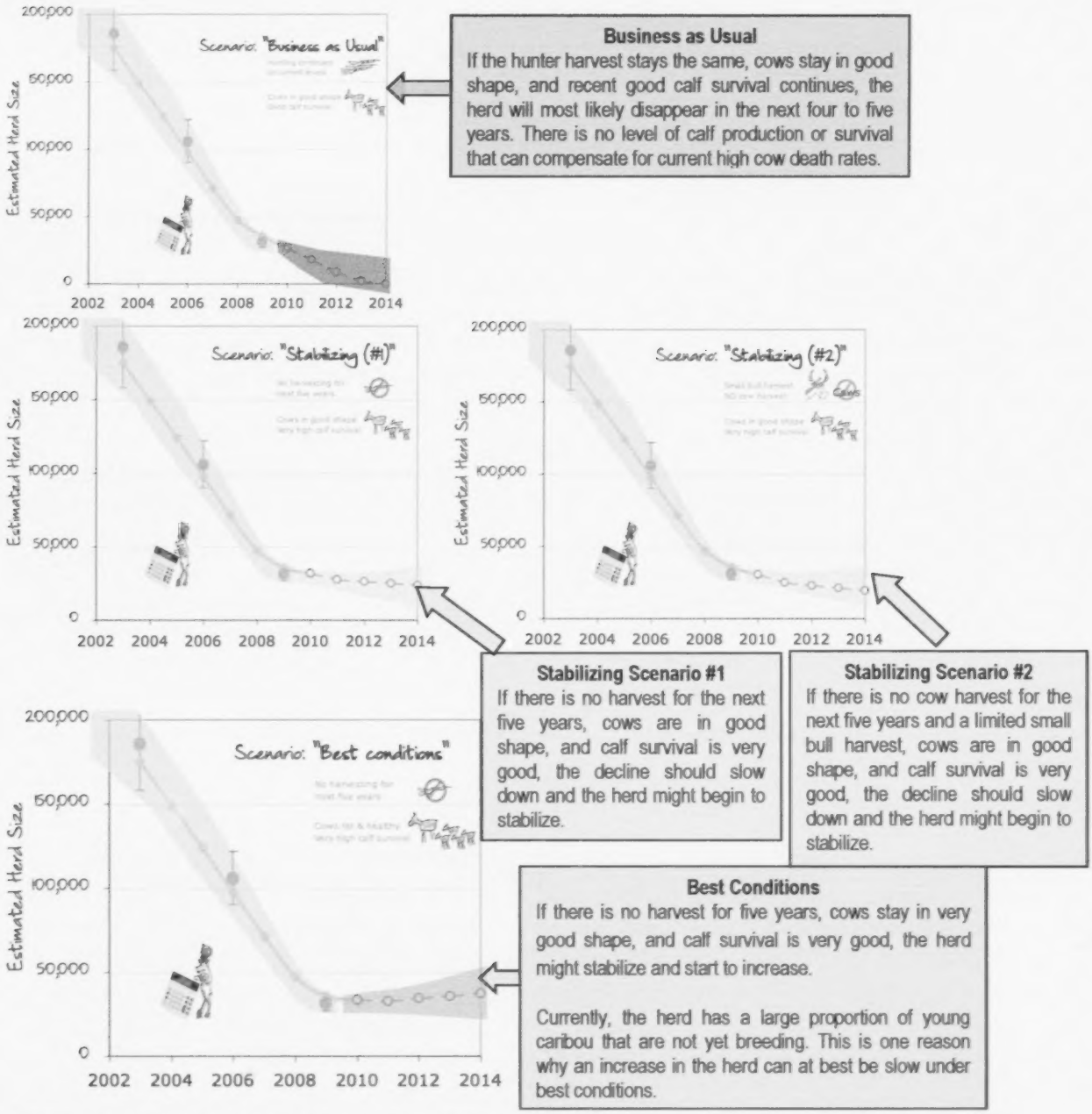

Scenario: "Business as Usual"
Scenario: "Stabilizing (#1)"
Scenario: "Stabilizing (#2)"
Scenario: "Best conditions"
Estimated Herd Size
200,000
150,000
100,000
50,000
0
2002 2004 2006 2008 2010 2012 2014
Business as Usual
If the hunter harvest stays the same, cows stay in good shape, and recent good calf survival continues, the herd will most likely disappear in the next four to five years. There is no level of calf production or survival that can compensate for current high cow death rates.
Stabilizing Scenario #1
If there is no harvest for the next five years, cows are in good shape, and calf survival is very good, the decline should slow down and the herd might begin to stabilize.
Stabilizing Scenario #2
If there is no cow harvest for the next five years and a limited small bull harvest, cows are in good shape, and calf survival is very good, the decline should slow down and the herd might begin to stabilize.
Best Conditions
If there is no harvest for five years, cows stay in very good shape, and calf survival is very good, the herd might stabilize and start to increase.
Currently, the herd has a large proportion of young caribou that are not yet breeding. This is one reason why an increase in the herd can at best be slow under best conditions.

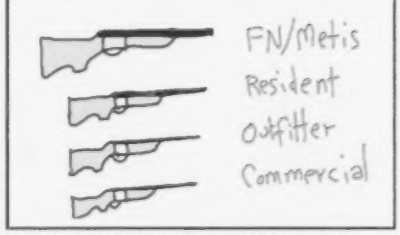
Figure 23: Possible outcomes of the Bathurst caribou herd using the Bathurst Caribou Calculator.

Managing the Bathurst Caribou Harvest

The information on the Bathurst herd's rapid decline and the role of harvest in the later stages of the decline were not easy for all participants to accept. However, people agreed that the decline was real and strong management actions would need to be decided on soon, and these would have to include reduced harvest. Projections from the Bathurst Caribou Calculator suggested that even with complete harvest closure and otherwise good conditions for the herd, stabilization and the beginning of a slow recovery are the best that could be expected over the next five years. Harvest of the Bathurst and other NWT barren-ground caribou herds falls into four classes: commercial tags, guided outfitters, residents and subsistence/Aboriginal hunt.

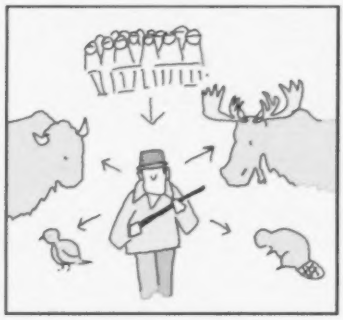
In the Inuvialuit, Gwich'in and Sahtu Settlement Areas, following priorities for allocation of harvest described in those land claim agreements, the co-management boards recommended, and GNWT implemented, closure of all commercial, resident and outfitted hunting in 2006. These actions were taken to assist the recovery of other caribou herds.

The priorities for allocating harvest in the Tłı̨chǫ land claim agreement is similar to the other NWT land claims, and if the Aboriginal harvest has to be restricted for conservation reasons, other kinds of hunting must first be restricted. The decision by Moise and Joyce Rabesca to voluntarily close their outfitted caribou hunting for the coming years was applauded by workshop participants.



There was discussion at both workshop sessions about restricting the Aboriginal harvest, which for the Bathurst herd is by far the largest proportion of the hunt, as with other barren-ground caribou herds in the NWT. Aboriginal leaders had already taken the lead in announcing actions to limit their hunt: Yellowknives Dene Chief Edward Sangris announced in September that their fall caribou hunt was cancelled this year. Similarly, Dene Nation Chief Bill Erasmus, Tłı̨chǫ Grand Chief Joe Rabesca and the other Tłı̨chǫ chiefs supported ENR Minister

Michael Miltenberger when the June 2009 Bathurst survey results were released to the media in September 2009. The Minister and Chiefs pledged to make tough decisions for the recovery of the caribou herd. Details of harvest management would be determined through the Tłı̨chǫ /GNWT joint proposal, WRRB hearings and recommendations, and consultation meetings with various groups.



Participants from various communities were asked about the alternatives they might have if they were unable to hunt caribou. Some participants pointed out that times of caribou scarcity had occurred before, and that Aboriginal hunters had fished and hunted bison, moose, beaver, muskoxen and woodland caribou during those times.

For most communities south of Great Slave Lake, there seemed to be several alternative sources of meat (especially bison), and some of these communities did not rely heavily on caribou.

The most difficult situation would likely be for the communities such as Lutselk'e and the Tłı̨chǫ communities, which have few alternatives to caribou, have a high cost of living and in some cases are not on the highway system. These communities would need help finding alternatives.

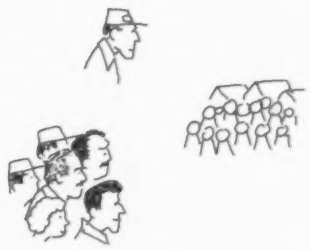
Final Thoughts

1. Joe Tetlichi stressed the importance of "walking together" in developing the Porcupine Caribou Harvest Management Plan. Several participants stressed the need for everyone to work together (communities and governments) for the recovery of the Bathurst herd.

2. Participants found the workshops informative but several participants pointed out the importance of bringing the information to all affected communities. The representatives from the communities who attended the workshops could help with this but GNWT needs to visit all communities.

3. A number of speakers emphasized the need for immediate action, including sacrificing in the present for the sake of future generations.

4. Some communities will experience real hardship if they cannot hunt caribou – this needs to be addressed.



5. The hunter harvest needs to be managed but management of the Bathurst herd needs to be comprehensive and consider both short-term and long-term actions.

6. The final words are from Danny Beaulieu's story:

"We are the descendants of the caribou. The caribou once helped our people to recover – now it's our turn to help them." Danny Beaulieu

(Photo credit: Archana Bali)

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APPENDIX 1. WORKSHOP PARTICIPANTS

Facilitator & Cartoonist Doug Urquhart (Whitehorse); Note-taker & Report-writer Lorien Nesbitt (Yellowknife)

Workshop Participants
(Alphabetic Order)

Jan Adamczewski (ENR)
Frank Arrowmaker (Gameti)
Archana Bali (University of Alaska student)
Danny Beaulieu (ENR)
Fred Beaulieu (Salt River First Nation)
Henry Beaver (Salt River First Nation)
Arthur Beck (NWT Métis Nation, Fort Resolution)
Grant Beck (North Slave Métis Alliance)
Stanley Beck (Deninu K'ue First Nation, Fort Resolution)
Joe Black (Behchokǫ̀)
Ernie Campbell (ENR)
Charlie Catholique (Lutsel K'e First Nation)
Bruno Croft (ENR)
William Chocolate (Gamèti)
Joe Dryneck (Wekweeti)
Mathieu Dumond (Government of Nunavut)
Audrey Enge (North Slave Métis Alliance)
August Enzo (Lutsel K'e First Nation)
Earl Evans (NWT Métis Nation, Fort Smith)
Ron Fatt (Lutsel K'e First Nation)
Susan Fleck (ENR)
Freddie Flunkie (Whati)
Bruce Football (Wekweeti)
Kerri Garner (Tłı̨chǫ Government)
Tina Giroux (Saskatchewan, Prince Albert Grand Council)
Gary Jaeb (caribou outfitter)
Ed Jones (North Slave Métis Alliance)
Alicia Kelly (ENR)
Russell Kenny (Délîne Renewable Resources Council)
Solomon King (Deninu K'ue First Nation, Fort Resolution)
George Lafferty (NWT Métis Nation)
Ray McDonald (Black Lake, Saskatchewan)
Richard Mercredi (NWT Métis Nation, Fort Smith)
Michael Miltenberger (ENR Minister)
Craig Nicolson (Univ. Massachusetts, Modeller)
Margaret Peterson (caribou outfitter)
Grant Pryznyk (Wek'èezhìi Renewable Resources Board)
Joyce Rabesca (Behchokǫ̀, caribou outfitter)
Moise Rabesca (Wek'èezhìi Renewable Resources Board)
Charlie Rabesca (Behchokǫ̀)
Camilla Rabesca (Sahtu Renewable Resources Board)
Fred Sangris (Dene Nation Caribou Committee)
Lance Schmidt (ENR)
Cate Sills (ENR)
Todd Slack (Yellowknives Dene First Nation)
Barry Taylor (caribou outfitter)
Joe Tetlichi (Porcupine Caribou Management Board)
Kevin Todd (GNWT Industry, Tourism and Investment)
Raymond Tutcho (Chief, Délîne First Nation)
Leslie Wakelyn (Beverly & Qamanirjuaq Caribou Management Board)
Charlie Zoe (Whati)

(Photo credits: Archana Bali)

APPENDIX 2. OVERVIEW OF JUNE 2009 BATHURST CALVING PHOTO SURVEY

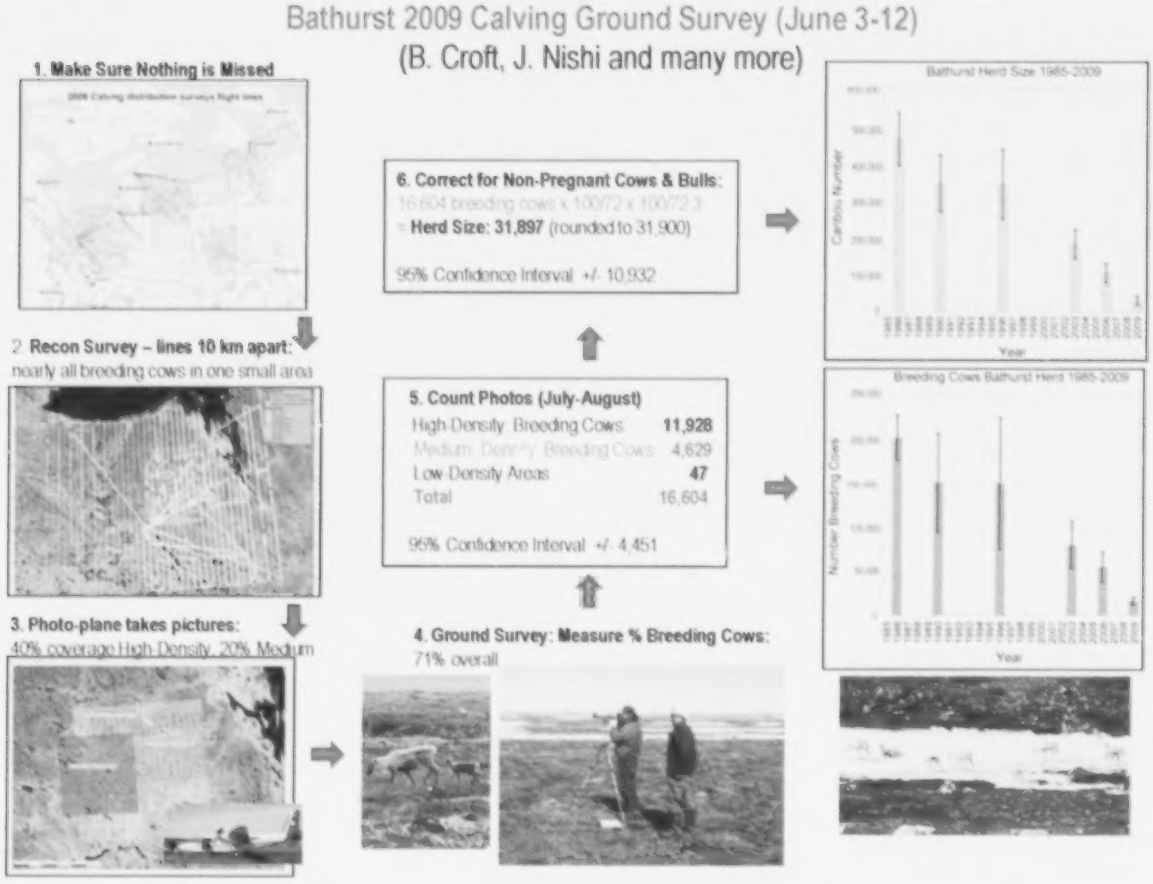
Bathurst 2009 Calving Ground Survey (June 3-12)
(B. Croft, J. Nishi and many more)
1. Make Sure Nothing is Missed
2. Recon Survey – lines 10 km apart:
nearly all breeding cows in one small area
3. Photo-plane takes pictures:
40% coverage High Density, 20% Medium
4. Ground Survey: Measure % Breeding Cows:
71% overall
5. Count Photos (July-August)
High-Density Breeding Cows 11,928
Medium-Density Breeding Cows 4,629
Low-Density Areas 47
Total 16,604
95% Confidence Interval +/- 4,451
6. Correct for Non-Pregnant Cows & Bulls:
16,604 breeding cows x 100/72 x 100/72.3
= Herd Size: 31,897 (rounded to 31,900)
95% Confidence Interval +/- 10,932
Bathurst Herd Size 1985-2009
Caribou Number
Year
Breeding Cows Bathurst Herd 1985-2009
Number Breeding Cows
Year

Figure 24: Bathurst caribou calving ground survey, June 3-12, 2009.

APPENDIX 3. RADIO COLLARED CARIBOU LOCATIONS DURING FALL HUNTING SEASON (AUGUST – SEPTEMBER)

The maps show radio collar locations during the fall hunting season in August and September 2007-2009, when barren-ground caribou outfitters were active.

Red x's are locations of Bluenose-East cows, green x's are Bathurst cows, and purple x's are Ahiak cows. The camps used by outfitters are black triangles.

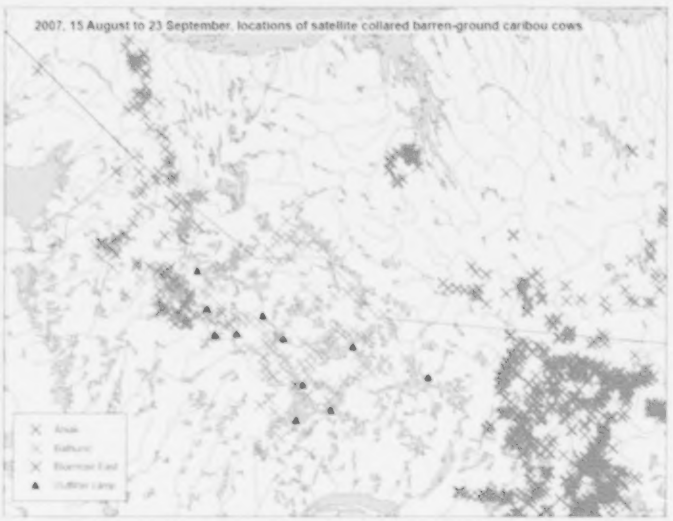

Figure 25: Radio collared caribou locations during the fall hunting season in August and September 2007.

In 2007, there were no Ahiak collars near the outfitter camps, and most of the camps had Bathurst collars in their area. Hunters at some of the western camps may have hunted Bluenose-East caribou, which overlapped with Bathurst caribou.

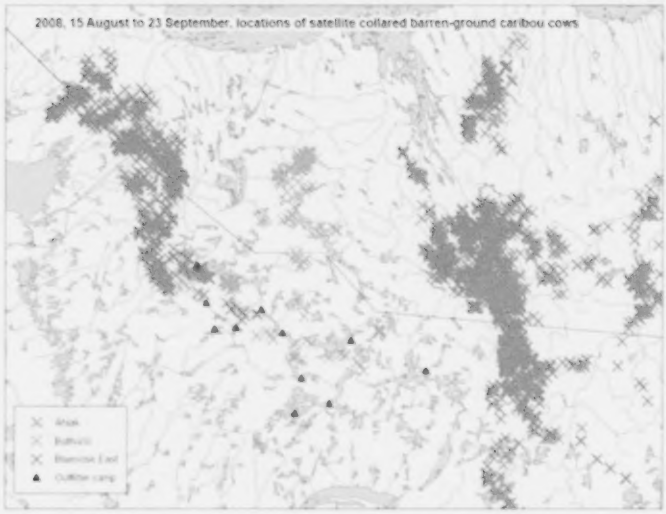

Figure 26: Radio collared caribou locations during the fall hunting season in August and September 2008.

In 2008, the pattern was similar. Overall the caribou were further north at this time of year.

Note that the numbers of crosses do not represent numbers of caribou in the three herds; they reflect the numbers of collars on caribou in the three herds over a period from August 15 to September 23. The number of collars on Bluenose-East caribou increased in 2008, as did collar numbers on Ahiak caribou. There have never been more than 20 collars on Bathurst caribou.

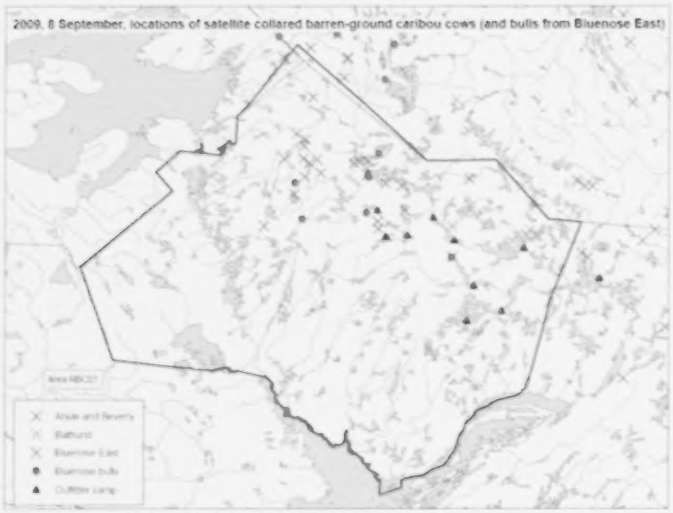

Figure 27: Radio collared caribou locations during the fall hunting season in August and September 2009.

The last map (above) shows a single day's collar locations on September 8, 2009. The additional locations in blue are Bluenose-East bulls. This would indicate that most of the outfitter camps in 2009 had Bluenose-East caribou nearby, and few Bathurst caribou.

APPENDIX 4. COLLARED CARIBOU WINTER LOCATIONS 2005-2009

These maps show caribou collar locations from January to April for each of the last five years (2005-2009). During this part of the winter, caribou tend not to move around much. Overlap between neighbouring herds is common in winter.

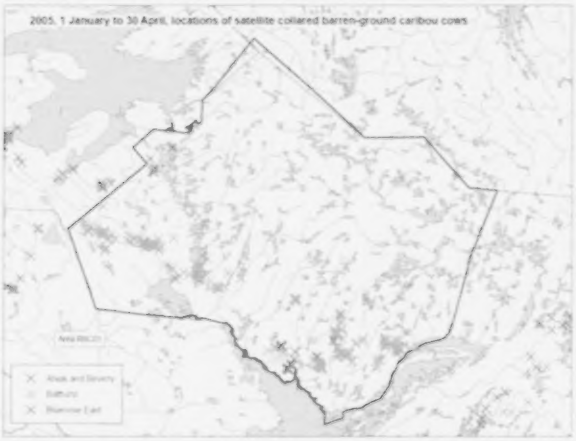

Figure 28: Radio collared caribou locations during the winter season from January to April 2005.

In 2005, Bathurst caribou (green) were scattered across a big area north of Great Slave Lake, with some overlap with Bluenose-East caribou (red).

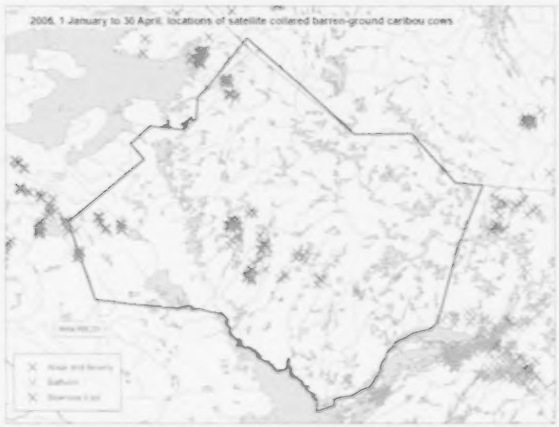

Figure 29: Radio collared caribou locations during the winter season from January to April 2006.

In 2006, Bathurst collars were mostly east of Great Slave Lake and overlapped with Ahiak collars (purple). Tłı̨chǫ hunters would have been hunting mostly Bluenose-East caribou.

Collars provide a great deal of information about caribou movements, migration, and habitat use. Collars can also give us some idea which caribou are likely being hunted from individual communities.

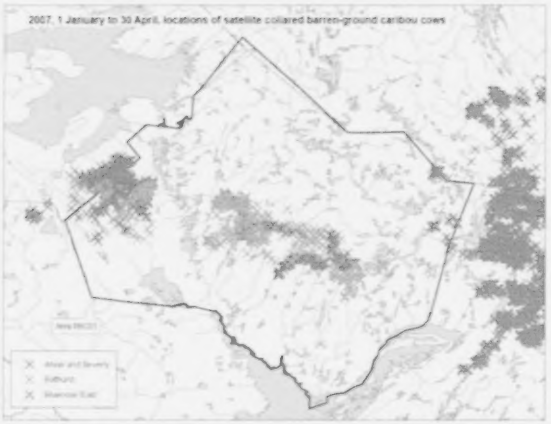

Figure 30: Radio collared caribou locations during the winter season from January to April 2007.

In 2007, the Bathurst collars were back north of Great Slave Lake and overlapped extensively with Bluenose-East caribou south of Great Bear Lake.

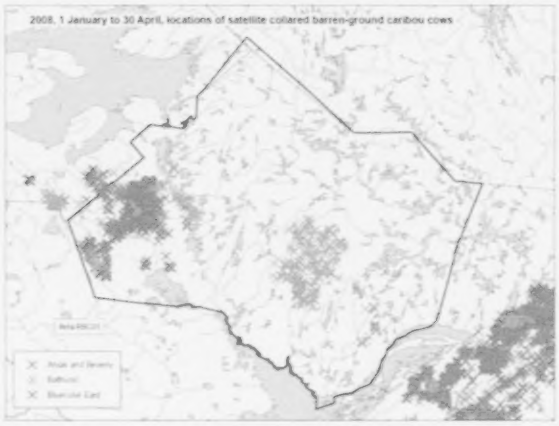

Figure 31: Radio collared caribou locations during the winter season from January to April 2008.

In 2008, collar locations were generally similar to the previous year.

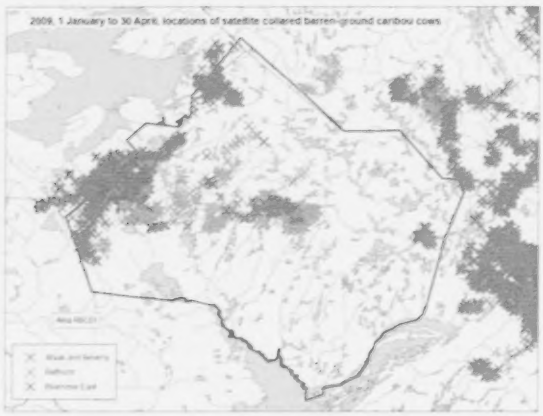

Figure 32: Radio collared caribou locations during the winter season from January to April 2009.

In 2009, many caribou wintered north of treeline in all three herds, possibly because of shallow snow on the tundra. Bathurst collars again overlapped extensively with Bluenose-East collars.

APPENDIX 5. COULD THE MISSING BATHURST CARIBOU BE SOMEWHERE ELSE?

When biologists report that a caribou herd has declined, a question that is often asked is whether the missing caribou could have gone somewhere else. Biologists addressed this question with a statistician (John Boulanger) at a technical meeting in late September 2009 by looking at radio collar movements between the Bathurst herds and its neighbours to the east (Ahiak herd) and west (Bluenose-East herd) and by evaluating population trend in the neighbouring herds.[2]

Radio Collars: Biologists have long observed that there is a low rate of collared cows switching to calving grounds of neighbouring herds. This has generally occurred at rates of 2-4% in both directions, which suggests little net loss to either herd. In other words, 96-98% of the time, collared cows will go back to the calving ground they used before. Alaskan biologists have reported similar results.

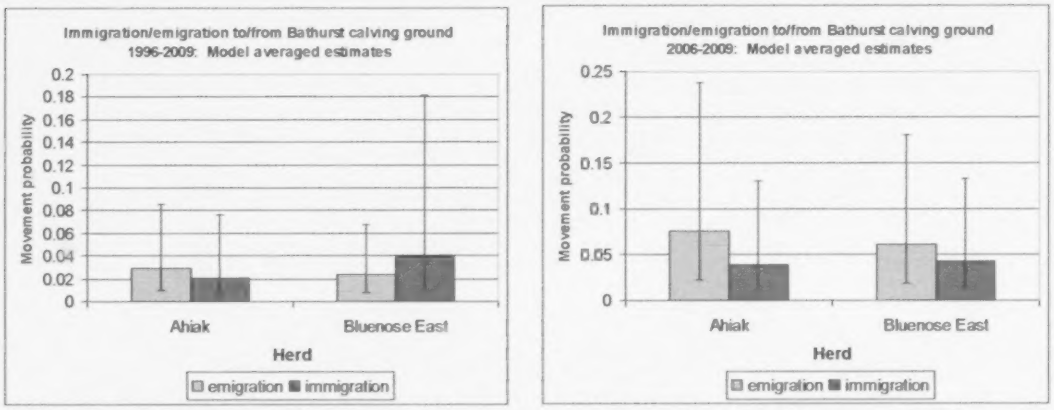

Figure 33: Immigration and emigration to and from the Bathurst calving ground during 1996-2009 and 2006-2009 model averaged estimates.

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[2] This analysis made use of collared cow information for the Bathurst herd and neighbouring herds until the fall of 2009. Further analyses could include more recent collar information from these and other herds and may change the outcome presented here.

The graph on the left shows that from 1996 to 2008, Bathurst collared cows moved to the Ahiak range at a 3% rate, while 2% of Ahiak collared cows moved to the Bathurst range. The exchange rate with Bluenose-East (BNE) cows was similar (2% of collared cows to BNE herd, 4% from BNE herd). Over the last three years (2006-2009 – graph on the right) on average 7% of collared Bathurst cows moved to the Ahiak range, while 4% of Ahiak collared cows moved to the Bathurst range. The larger percentages mostly reflect limited collar numbers and lower sample size in the Bathurst herd. The exchange rates with the Bluenose-East herd were similar. A larger number of radio collars would provide more confidence in these calculations, but there was no evidence of a large-scale movement to or from the Bathurst range.

Ahiak Herd: Calving reconnaissance surveys on the Ahiak calving ground were carried out by GNWT in 2006, 2007, 2008 and 2009, over the same period of the recent Bathurst decline. These surveys do not provide a precise population estimate, but when done consistently, they give a clear index of trend.

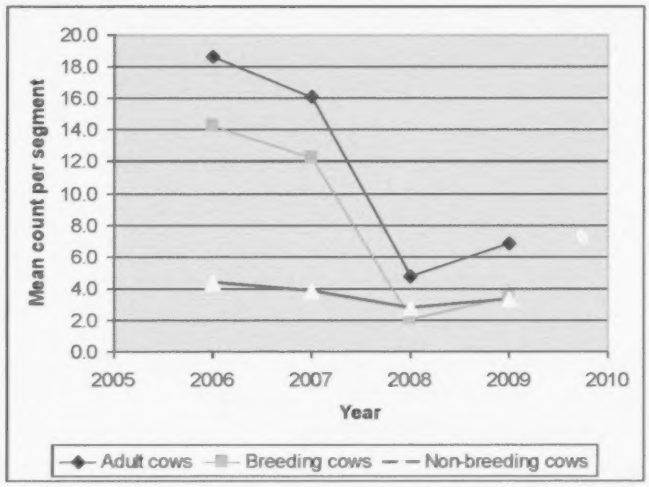

Figure 34: Average number of Ahiak caribou seen per 10 km survey segment from 2006-2009. (Graph: John Boulanger)

Note: Adult cows are the sum of the breeding and non-breeding cows; Ahiak herd, 2006-2009.

Preliminary analysis by John Boulanger of the average number of caribou seen per 10 km survey segment on the Ahiak surveys suggests that the number of cows on the Ahiak calving ground in 2009 was about 40% of the number in 2006.

A substantial decline in Ahiak caribou from 2006 to 2009 makes it rather unlikely that there was a large movement of Bathurst caribou to the Ahiak range.

Bluenose-East Herd: In 2000 this herd was estimated at about 120,000. From 2000 to 2005/2006, its numbers dropped by nearly 50% to 65,000 in 2006. A post-calving photo survey of this herd was attempted in July 2009, but was unsuccessful because caribou did not group up into tight groups suitable for photography. This survey method can provide precise population estimates but it requires hot weather in July to make insects highly active. Caribou may form large groups of several thousand in response to such conditions, and these groups can then be photographed and counted to provide a population estimate.

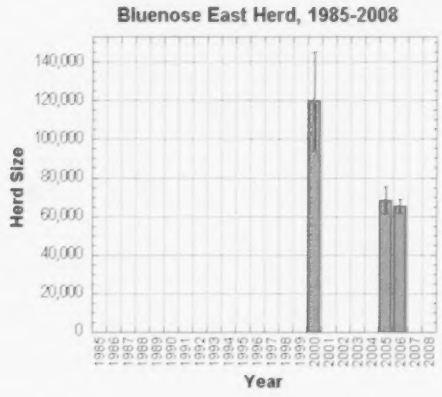

Figure 35: Post-calving photo survey results of the Bluenose-East caribou herd from 1995-2008.

Survey Coverage: In recent years GNWT biologists have flown many thousands of kilometers of surveys in June and July. The map on the left (below) shows calving distribution surveys in June 2008. There were many days of additional flying done to show where calving caribou were and where they were not, and to demonstrate the separation between calving

grounds. The map on the right (below) shows the approximately 59,000 km flown in June 2009. The area covered is vast, and much of the extra flying was done to verify that no large groups of calving caribou were missed. The chance of missing a large number of caribou becomes very unlikely with this level of survey flying.

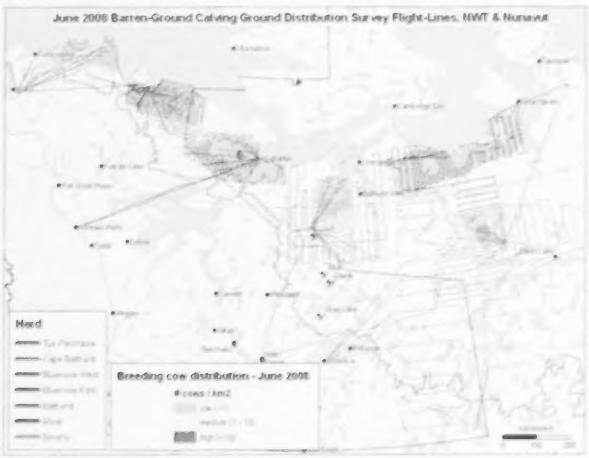
June 2008 Barren-Ground Calving Ground Distribution Survey Flight-Lines, NWT & Nunavut
Herd
Breeding cow distribution - June 2008

Figure 36: Barren-ground caribou calving ground distribution survey flight lines, June 2008.

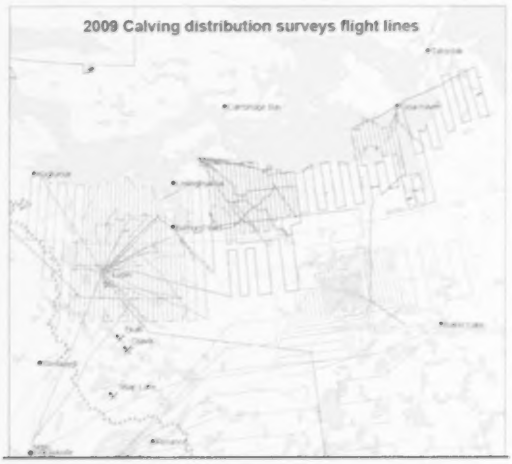

Figure 37: Barren-ground caribou calving distribution survey flight lines, 2009.